Atomic Energy Control Board
P.O. Box 1046
Ottawa, Canada
K1P 5S9

Commission de contrôle de l'énergie atomique
C.P. 1046
Ottawa, Canada
K1P 5S9

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RADIATION PROTECTION: PRECEDENTS, PRINCIPLES AND PRACTICES - A REGULATORY VIEWPOINT

by

J.H. Jennekens

Atomic Energy Control Board
Ottawa, Canada

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Paper

RADIATION PROTECTION: PRECEDENTS, PRINCIPLES AND PRACTICES - A REGULATORY VIEWPOINT

J.H. Jennekens, President
Atomic Energy Control Board

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ABSTRACT

Radiation protection in its broadest sense is a multidisciplinary human function exemplifying in all meaningful respects the innate ability of dedicated persons to apply with both general and specialized expertise knowledge derived from a great many scientific and technical fields. Radiation protection practitioners characteristically pursue their activities without fanfare, and not unexpectedly, the fundamental importance of their contributions to the research, medical, industrial, agricultural and educational applications of ionizing radiation is too often overlooked or underestimated. The aim of this address is to outline from a regulatory viewpoint the precedents, principles and practices of radiation protection, a very essential human function.

RÉSUMÉ

La radioprotection, dans son sens le plus large, est une activité humaine multidisciplinaire qui prouve à maints égards l'abilité innée de certaines personnes à mettre à profit leur expérience générale et spécialisée dans l'application de connaissances scientifiques et techniques empruntées à plusieurs domaines. Ceux qui s'occupent de radioprotection poursuivent normalement leurs activités sans tambour ni trompette et c'est sans doute ce qui explique pourquoi l'importance fondamentale de leurs contributions aux applications des rayonnements ionisants en recherche, en médecine, dans l'industrie, en agriculture et en éducation est trop souvent ignorée ou sous-estimée. La présente communication vise donc à souligner, du point de vue de la réglementation, les précédents, les principes et les pratiques de radioprotection comme activité humaine essentielle.

1. Introduction

The first conference of the Canadian Radiation Protection Association was held in a year during which most Canadians were preoccupied with a host of national and international developments. For many Canadians, the year 1980 will be remembered primarily for the intense debates over patriation of the Constitution. However, very few would associate the debate with Premier Lougheed's reference to "the uranium thing".

Among the many issues involved in the constitutional debate was a concern on the part of provincial premiers over the possible extension of federal controls into the area of natural resources by means of the declaratory power of the federal government under section 92.10 (c) of the British North America Act. In 1946, the federal government invoked this provision of the BNA Act by declaring in section 17 of the Atomic Energy Control Act certain "atomic energy" works and undertakings to be works "for the general advantage of Canada". Herein lies the explanation for the reference to "the uranium thing".

The referendum in Quebec and the initiative known as the Western Canada Concept were significant events in 1980 which contributed immensely to the continuing preoccupation of Canadians with what some sectors of the media repeatedly headlined as the continuing doubt on the part of most Canadians about their national destiny.

Also in 1980, Bill C-43, the Access to Information and Privacy Act was introduced in Parliament.

Earlier in the year, the long awaited report of the Ontario Royal Commission on Electric Power Planning was submitted to the province's Lieutenant-Governor, the Honourable Pauline McGibbon. Among its many conclusions and recommendations, the Commission advised that "The Atomic Energy Control Board, or its eventual successor, must not become a victim of government spending restraints". In the context of this Conference, the Commission's view that "...there remains considerable diversity of opinion concerning radiation-induced human carcinogenesis..." is clearly of greater relevance. Also in 1980, the report of an inquiry by Mr. Justice Samuel Grange of the Ontario Supreme Court into the November 10, 1979, derailment and tank car explosion in Mississauga was handed down.

On the international scene, 1980 witnessed the arrival of a large contingent of USSR troops in Afghanistan. Closer to home, the CBC reported that dioxin and other highly toxic wastes were entering the Niagara River from both abandoned and currently operating chemical waste dump sites on the United States side of the river.

What this brief summary of 1980 events means to each of us is an interesting question. For me it means that a period of five years slips by very quickly, and my recollection of the specifics of a particular event which occurred five years ago is very limited. The summary also tells me that so-called nuclear issues are not easily explained let alone resolved and that the passage of time by itself provides no grounds for assuming that positive actions taken in response to the needs of the day will produce positive results.

Perhaps the following excerpt from the House of Commons debates will illustrate the point:

"...There is an almost complete lack of knowledge of this whole question, not only in this House, but, I submit, throughout the country. ..... Our people are not informed on all facts in connection with atomic energy. It should be fundamental that the people as a whole have some understanding of these problems before legislation is passed in the House, otherwise our democracy is not functioning properly."

The speaker was the Honourable Howard Green and the date was June 11, 1946.

Careful examination of Mr. Green's comments will reveal that they are as valid today as they were 39 years ago. Apart from a cyclical flurry of interest in atomic energy on occasions when the media attempts to spark a little effort to broaden the common understanding of the issues involved, initiatives by the Board and others to address what Mr. Green termed a fundamental prerequisite for the proper functioning of our democracy have been only modestly successful. The polemics indulged in by ostensibly responsible persons in commenting on this subject is a story in itself. Fortunately, a philosophical, largely stoical contemplation of the matter helps to provide a certain degree of relief. As President Washington once advised, "to persevere in one's duty and to remain silent is the best answer to calumny." To be honest, however, I always have difficulty in reconciling this advice with the age-old adage, "Silence means consent."

The brief summary of 1980 events also tells me that in order to understand the essentials of a particular human endeavor it is imperative that a reasonable knowledge of its origins be gained. As a layman in the field of radiation protection, I am mindful of the ageless admonition that "a little knowledge is dangerous". However, I am equally aware of Thomas Huxley's view that "if a little knowledge is dangerous, where is the man who has so much as to be out of danger?" Since no radiation protection practitioner would presume to be completely knowledgeable about every aspect of his or her profession I have no hesitation about continuing this address.

2. Precedents, Principles and Practices - Reason and Judgement Being the Common Element

To a lexicographer the difference in meaning between the words precedent, principle and practice may be easily explained. I expect that in the field of radiation protection an approved practice means a procedure or activity developed on the basis of relevant principles and for which there can usually be identified one or more precedents. Naturally, when we speak of precedents we mean good precedents, although few persons would disagree with Julius Caesar's admonition that "All bad precedents began as justifiable measures" - at least that is, in the view of the initiator.

In order to gain some insight into the early development of radiation protection principles and practices, I reviewed several of Lauriston S. Taylor's wonderfully informative papers on the subject. Needless to say, I soon began to feel quite comfortable about certain aspects of the subject, and in searching through the Board's library I found several more enlightening articles by other authors. I also came across a reference to an old Irish proverb, "Everyone is wise until he speaks" at which point I began to wonder if I should look for another theme for this address.

Lauriston Taylor's papers reminded me that Wilhelm Konrad Roentgen discovered X-rays the year that Babe Ruth was born. Before Ruth had spoken his first word, some of the adverse biological effects of X-rays had been observed and

precautions were introduced to limit the exposure of persons to ionizing radiation. Leading members of the scientific community were grappling with a series of new discoveries and it fell to a handful of persons in Germany and England to develop the first general recommendations governing the diagnostic and therapeutic uses of ionizing radiation. A rapid traverse of the first half of the 20th century reveals that enormous advances were made in understanding the biological effects of ionizing radiation and in improving the effectiveness of equipment and procedures for controlling and minimizing exposures. More recently, the concepts of justification of practices and optimization of radiation protection evolved and became progressively clearer with the publication of ICRP-9 in 1965, ICRP-22 in 1973, ICRP-26 in 1977 and ICRP-37 in 1983. Nevertheless, even today, with the very impressive national and international capabilities which exist for the codification and implementation of radiation protection programs there remain a number of important issues for which early resolution appears to be beyond our grasp. The tragic incidents in Mexico and Morocco of 1983 and 1984 involving the use, or more correctly the mis-use, of radioisotopic devices serve as compelling testimony to the need for more effective controls.

In many instances this need is often misunderstood or misrepresented. The fundamental principles of radiation protection were developed at a time when the fortunate few who attended institutions of higher learning were drilled in the classics. The ancient Greek and Roman scholars had developed what were obviously the precursors of the scientific method and of the system of jurisprudence known as the common law. The exercise of judgement based upon a coherent, systematic examination of the relevant facts is the underlying basis of the scientific method and of common law. Recognizing the multi-disciplinary scientific and technical training of persons involved in radiation protection, it is evident why the exercise of judgement characterizes every aspect of the profession from the establishment of standards to their practical implementation. A key prerequisite for the proper exercise of judgement is a solid understanding of the relevant facts and a commitment to the continued broadening and deepening of that understanding. Indicative of this commitment on the part of radiation protection practitioners are the results of compliance inspections by AECB staff and the evaluation of reports submitted to the Board in accordance with licence conditions and the provisions of the Atomic Energy Control Regulations.

Before reviewing the basic principles of radiation protection from a regulatory point of view, I believe it would be appropriate to recall, in the context of the public's interest and concern over all environmental protection matters, the observation of the members of the United Kingdom Royal Commission on Environmental Protection who in the introduction to Chapter V of their sixth report stated:

"....We have been impressed by the relatively much stricter regime that prevails with respect to ionizing radiation than in the field of toxic chemicals. The result has been an exemplary record in the nuclear industry world-wide of protection of the health of both radiation workers and the general public. Indeed, we are strongly of the view that many of the practices for the protection of human health that are common in the radiation field could and should be adapted for application in other areas...."

There have, of course, been a few exceptions to this exemplary record. However, these exceptions are more a result of the constraints placed upon the involvement of radiation protection specialists in the instances involved rather than any weakness in their knowledge or competence. Herein lies a call

for the profession to accelerate the development and implementation of consistent and uniform standards of radiation protection on a world-wide basis.

Turning now to a brief review of the fundamental principles of radiation protection, I will attempt to outline their importance to a regulatory agency in its consideration of a licence application and its subsequent compliance activities:

1. prudence dictates that all exposure to ionizing radiation must be considered to be potentially harmful. As a consequence, all exposures must be kept "as low as reasonably achievable". This principle was originally formulated somewhat differently (i.e. "the lowest possible level", then "as low as practicable" and "as low as readily achievable"), however, all formulations imply the exercise of judgement in the process of systematically examining, analyzing and evaluating all pertinent factors and arriving at a decision which reflects knowledge, common sense and experience. A nuclear regulatory agency searches for substantive evidence that the required judgement has been exercised both as a prerequisite for the issuance of a licence in the first instance and as an indicator of the probability of fully satisfactory subsequent compliance with licence conditions.

   Although sometimes maligned and often interpreted differently, the ALARA principle has been of unquestioned importance to the radiation protection practitioner and to the regulatory agency. As an engineer, I believe that the ALARA principle is totally consistent with the Code of Ethics of Professional Engineers in the sense of applying an "engineering approach" to radiation protection. Similar analogies exist for each of the many scientific and technical disciplines which are represented in the profession of radiation protection;

2. activities involving exposure to ionizing radiations must be justified and the radiation protection measures which are to be applied to these activities must be optimized. I prefer to mention these two principles together recognizing that "justification" implies a comprehensive analysis of the total benefits and detriments of a given activity whereas "optimization" involves only the net difference between alternative radiation protection measures.

   From a regulatory standpoint, the justification for a proposed activity or practice inherently involves a meaningful prior assessment of all relevant factors thus introducing such aspects as the requirement for preplanning. As a consequence, the avoidance of all unnecessary exposure becomes an obvious corollary and its importance in the overall system of dose limitation is soon recognized; and

3. all exposures must be kept within prescribed limits. This principle encompasses not only the statutory dose limits established by national regulatory agencies but also the "control" and "administrative" limits stipulated in the radiation protection programs of licensees. In addition to the basic rationale for dose limits, implementation of the principle as a regulatory requirement enables both the licensee and the regulatory agency to assess the effectiveness of radiation protection measures on a current basis with retrospective reviews providing the final verification of compliance. As indicated earlier, simple compliance with dose limits is not a sole and sufficient criterion for

assessing the acceptability of a radiation protection program. By their very nature "control" and "administrative" limits invariably involve the application of the ALARA principle. Equally important is the consideration of collective dose which extends beyond simple compliance with dose limits for individuals.

3. Conclusion

During the lifetimes of those attending this Conference considerable progress has been achieved in improving the quality of life as the result of scientific and technological advances. The radiation protection profession has been an important contributor to these advances. The days in which the most common method of dose measurement was described in terms of the amount of radiation required to produce a "threshold erythema" are long since past. Today the profession has at its disposal a range of scientific and technical tools which even a few decades ago were beyond the capabilities of the most industrially advanced nations. However, with all of these tools the fundamental need remains for reasoned judgement based upon knowledge, common sense and experience. These are and must remain the attributes of the radiation protection practitioner.

Considerable progress has also been made in the minimization of exposures to radiation resulting from the many and varied uses of ionizing radiation. Hopefully, in the interest of the equitable management of the risks posed by our technology-oriented society, the principles and practices of radiation protection can be applied to the control of such hazardous materials as lead, mercury, chromium, arsenic, cyanide and the great many other toxic materials involved in everyday commerce. For the foreseeable future, the question will remain as to whether or not the controls applied to all mutagenic and carcinogenic hazards are as rigorous and effective as those applied to ionizing radiation. This question poses a challenge to society and it is a challenge which can be successfully met if we can utilize the talents, knowledge and dedication of the radiation protection practitioner.

In an opening address to the founding meeting of the Canadian Radiation Protection Association in 1979, my colleague Mr. W.R. Bush made the following statement which I would like to reiterate because of its continuing validity:

"The primary responsibility for radiation protection logically belongs with the licensee, because he and his staff are closer to the radiation protection problems of his organization and are therefore in a better position than the AECB to determine the best protection. The AECB in turn has a responsibility to audit the operations and to assure that adequate radiation protection is in fact being applied. In the event of a difference of opinion between the AECB staff and a licensee, the matter is discussed and debated until a mutually acceptable solution is found. Experience has shown that licensees often apply stricter radiation protection controls than the AECB would require, but a more-or-less gentle prod from the AECB staff is occasionally required in order to catalyse the process.

The AECB has only rarely had to force compliance by resorting formally to its legal authority. The regulatory approach of dialogue and persuasion has proved to be effective, requiring a minimum of regulatory staff and leaving the primary responsibility for radiation protection where it belongs: at the workplace with the licensee."

The program of this Conference covers a very broad spectrum of radiation protection activities and I expect that the many papers, posters and displays to be presented will significantly enlarge the collective understanding of the profession which performs, quite clearly, a very essential human function.